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Comment on "Two Disks in a Box"

[R. J. Speedy, Physica A **210**, 341 (1994)].

W. G. Hoover*

Lawrence Livermore National Laboratory,

Department of Applied Science,

University of California at Davis/Livermore, Post Office Box 808,

Livermore, California 94551-7808

In contradiction to the widely-held view that phase transformations can only be associated with *infinite* systems, Speedy[1] showed that the partition function for a periodic *two*-disk system has a van der Waals' loop resembling, qualitatively, that found by Alder and Wainwright in their investigations of the melting-freezing transitions of hard disks and spheres some thirty years ago[2]. This analog, as well as its extension to nonsingular repulsive potentials, has been noted before. In 1963, Alder, Hoover, and Wainwright[3] called attention to the van der Waals behavior of two hard disks, using periodic boundary conditions suited to the close-packed triangular lattice. Compare the Figure in Reference 3 with Speedy's Figure 1. It was pointed out in Reference 3 that the pressure and density for the two-body transition lie within 10% of those estimated for hard disks in the thermodynamic limit[4]. Similar analytic results were pointed out for periodic systems of a few hard squares[5].

References:

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1. R. J. Speedy, "Two Disks in a Box", Physica A **210**, 341 (1994).
2. See, for instance, the discussion in Chapter 6 in W. G. Hoover, **Computational Statistical Mechanics** (Elsevier, Amsterdam, 1991).
3. B. J. Alder, W. G. Hoover, and T. E. Wainwright, "Cooperative Motion of Hard Disks Leading to Melting", Physical Review Letters **11**, 241 (1963).
4. W. G. Hoover and F. H. Ree, "Melting Transition and Communal Entropy for Hard Spheres", Journal of Chemical Physics **49**, 3609 (1968).
5. W. G. Hoover and B. J. Alder, "Studies in Molecular Dynamics. IV. The Pressure, Collision Rate, and Their Number Dependence for Hard Disks", Journal of Chemical Physics **46**, 686 (1967).